Congressional Testimony

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Addressing Medical Aspects of Biological Terrorism with a focus on Anthrax

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COL Edward Eitzen, M.D., M.P.H., United States Army
Commander
U.S. Army Medical Research Institute Of Infectious Diseases (USAMRIID)
1425 Porter Street
Fort Detrick, Maryland 21702-5011
(301) 619-2833
Email: edward.eitzen@det.amedd.army.mil

Prepared Statement

Mr. Chairman, distinguished members of the subcommittee, it is my pleasure to appear before you to discuss the possible impact of biological terrorism on the United States and its citizens, and the medical responses to these threats, with a particular focus on anthrax. The threat of biological terrorism is really a spectrum of threats, and the medical responses are different depending on the agent used by the perpetrators. Today I will briefly discuss biological terrorism in general, and then focus specifically on one of the most likely agents to be used as a terrorist weapon, *Bacillus anthracis*, most commonly known as anthrax.

My qualifications to speak to you on this issue include my service for the past ten years, first as the Chief of the Operational Medicine Division and now as the Commander, of the DoD's lead biological defense laboratory located at Fort Detrick, Maryland, the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID); USAMRIID is a subordinate unit of the U.S. Army Medical Research and Materiel Command (USAMRMC) under MG John S. Parker, and of the U.S. Army Medical Command (USAMEDCOM) under LTG James Peake. USAMRIID is the primary Army laboratory concerned with medical biological defense. The unit's mission is to develop the strategies, products, information, diagnostics, education and training related to medical defense against biological warfare (BW) or biological terrorism (BT), or against naturally occurring disease agents which require special containment. The laboratory has special containment features including bio-containment levels 3 and 4 isolation, which are the two highest levels of laboratory containment, as well as a limited bio-containment level 4 patient care capability, and an Aeromedical Isolation Team (AIT). In addition to the special physical features of USAMRIID, the Institute has people with special expertise in many fields of the biological sciences and medicine and a supportive Command structure which enable us to perform our important mission for the Army, the DoD, and the nation. USAMRIID is one of only two large bio-containment level 4 laboratories in the United States, the other being at the Centers for Disease Control and Prevention (CDC).

Biological terrorism (BT) is the intentional use of microorganisms - bacteria or viruses, or of toxins derived from living organisms, to produce death or disease in our citizens. The CDC has characterized biological threat agents into three major categories - A, B, and C - based on factors including likelihood of use for bioterrorism, medical consequences, need for special preparations to respond to an attack, ability to be weaponized, and communicability of the agent from person to person. Six biological agents are categorized in the highest threat category A: anthrax, smallpox, plague, tularemia, botulinum

toxins, and the viral hemorrhagic fevers (VHF's), which are a group of viral agents which include ebola and Marburg viruses. Anthrax and smallpox are probably the most important of these six level A agents, smallpox because of its up to 40 percent lethality and high communicability from person to person, and anthrax because of its easy availability, stability, and high mortality (80 to 100 percent fatal in the inhalation form of the disease). Biological agents could be delivered in several ways, but the most important is via the inhalation route (through the lungs of the victims), because of the mass casualty potential associated with inhalational exposure. Oral and percutaneous (injection through the skin) delivery is also possible for some agents, but these routes are less important than the aerosol route. Large water supplies would most likely dilute the agents enough to lower the dose below the threshold for disease, and chlorination of water supplies would inactivate some biological agents. Focal contamination of local food and smaller water supplies would be potentially feasible, however.

Effective aerosol delivery of biological agents depends on a number of factors. These include the particle size of the agent, formulation, medium (liquid versus dry), method of delivery, meteorological factors, and other issues that make an effective aerosol attack very tricky for the perpetrator. Particle size is very important, because if the particle size is too large, the agent will not get into the lungs and distal small airways of the targeted victims. Quite a bit of expertise is needed to create a "weaponized" agent, but this type of expertise is available, and the technical barriers are not insurmountable. An effective aerosol attack could, under the right weather conditions, cover a much larger geographical area with an infectious or toxic dose than is true for chemical weapons. In a worse case scenario, hundreds of square miles could be covered. The area of coverage is also agent dependent, with the more stable agents like anthrax (particularly the spore form) capable of wider area coverage.

I mentioned at the start of my statement that potential biological terrorism is really a spectrum of possible events - from a letter with an inert powder and a threat in it - a hoax - to the opposite end of the spectrum - a large scale attack under the right weather conditions with a well-weaponized and effectively delivered lethal agent producing thousands or even tens of thousands of casualties. The former is highly likely to occur, with hundreds of events a year but minimal or no casualties, and the latter type of event is much less likely to occur, but the chance of it occurring is not zero. In between those two polar ends of the spectrum are attacks that could produce a lesser number of victims, but may still have a great impact. Witness the public consternation over even one case of fatal anthrax in Florida this past week. In the wake of the well coordinated and massively lethal terrorist attacks last month in New York City and Washington DC, there are those who may have begun to challenge the previous assumption by some that the more devastating end of the bioterrorism spectrum could never occur. Also, the prospect that we have now a perpetrator "out there" who knows how to create a respirable aerosol is unsettling.

Let's focus now on anthrax, the agent most often mentioned as the "ideal" biological weapon. Anthrax is really the disease caused by *Bacillus anthracis*, a bacterium which forms spores, which are a hardened, encapsulated form of the bacterial agent. The spores are very hardy, and can last in the environment for a very long time, even years when they are protected from sunlight. When these spores enter an animal or human body, they "germinate", or turn into the vegetative bacterial form. Anthrax causes mainly animal disease in nature, infecting cows and other grazing animals, and humans are usually only infected by contact with affected animals, either by skin contact or by consuming contaminated meat. The most common natural form of the disease in humans is an anthrax skin infection (cutaneous anthrax), which is readily diagnosed and easily treated with antibiotics. The more deadly inhalational form of anthrax, contracted through the lungs, is very rare in humans naturally, occurring mainly in

people who work in certain occupational settings (wool mills - "woolsorter's disease"). There were only 18 reported human cases of inhalational anthrax during the entire 20th century in the U.S. medical literature. The case reported in Florida this past week is the first reported apparently inhalational case since the mid 1970's, mainly because the anthrax vaccine has been used in at-risk occupational settings since that time, and we believe it is protective against aerosol exposure.

Inhalational anthrax is the form of the disease we would expect to see with an effective aerosol bioterrorist attack. The spores enter the farthest reaches of the lungs of victims, and then would be carried into the center of the chest, and area called the mediastinum. The spores would germinate and vegetate, start to multiply rapidly and produce several toxins, and ultimately get into the blood stream and move to other organ systems (bacteremia). After inhalation, there is usually a period without symptoms of 1 to 3 days (the incubation period). If the dose inhaled is low, as occurred in an accident in Sverdlovsk, USSR in 1978, the incubation period may be as long as 6 weeks before cases occur.

The initial symptoms in the first 24 to 48 hours after the incubation period are nonspecific - fever, malaise, headache and body aches, and possibly some chest pain - symptoms common to a lot of "everyday" illnesses, such as influenza. However, at 48 to 72 hours after onset of symptoms, possibly later, the patient will rapidly worsen, with onset of respiratory difficulty, organ system failure, low blood pressure, and death in another 24 to 48 hours. A widened mediastinum (widening of the middle area of the chest on X-ray resulting from mediastinal infection or "mediastinitis") is often seen at this point in the disease course. Meningitis, a serious infection of the layers covering the brain, occurs in up to 50 percent of patients. At a certain point in this process, when the bacterial organisms have disseminated widely and multiple organs are involved, treatment is not likely to be effective. However it is not true that the patient is necessarily doomed from

the onset of the earliest symptoms. There are limited animal experiments that show effective antibiotic treatment is possible even after bacteria are present in the blood stream, and in some cases even after the development of mediastinitis.

Treatment of inhalational anthrax involves the use of antibiotics that may include penicillin, doxycycline, or ciprofloxacin, and intensive supportive care to include ventilatory support in many cases. The earlier treatment is started, the better the chances for survival. Thus, early diagnosis of anthrax cases is very important. Disease surveillance systems that can pick up new cases of disease (occurring in a given area) in nearly real-time are under development and may prove to be extremely helpful in limiting casualties from a large-scale anthrax attack. Sensitive and specific medical diagnostic technologies such as those used at USAMRIID can give a presumptive diagnosis fairly rapidly - within a few hours - and CDC is making such capabilities available through its Laboratory Response Network (LRN), which is a tiered system of laboratories at level A through D, with CDC and USAMRIID being the two level D laboratories. Department of Health and Human Services (HHS) stockpiled antibiotics, vaccines, and ventilators that can be moved rapidly to the site of an outbreak may be critical in limiting mortality. Early diagnosis and early treatment are the keys to an effective response, as mortality is high, nearing 100 percent, when the treatment is instituted in the late stages of disease.

Those thought to be exposed but who are still asymptomatic may be started on post-exposure antibiotics and also vaccinated with anthrax vaccine if it is available. The regimen is 30 days of antibiotics and three doses of vaccine over a month's period of time. If vaccine is not available, antibiotic treatment must be extended to 60 days post-exposure, as there may still be enough spores in the lungs to cause disease without the immunity produced from the vaccine to fight off the infection.

Although there are still areas where the United States can continue to bolster preparedness for biological terrorism (such as producing more smallpox vaccine and antiviral drugs to fight smallpox, for instance), I believe that we have made significant progress in the last two to three years. There are three major areas that will help us to be more prepared: the first being a strong public health system, with excellent surveillance systems to rapidly detect an outbreak, state of the art laboratories to tell us what disease agent we are facing, and strong research programs to develop new countermeasures; the second being strong educational programs to make biological "first responders" (emergency and primary care physicians and nurses, public health personnel, and clinical laboratorians) aware of the clinical symptoms, initial treatment, laboratory procedures, and reporting mechanisms that they need to know to detect and manage an outbreak. An example of such a training program is the USAMRMC/USAMRIID satellite distance learning course entitled "Medical Management of Biological Warfare and Terrorism", which has trained more healthcare professionals in this country than any other such program - over 52,000 healthcare providers in the last four years. The third major area is to make sure that we have adequate capacity in the healthcare system - which is now not present for a large-scale attack - to be able to treat the casualties.

With cooperation among federal, state, and local agencies and certain important preparations including manufacture and national stockpiling of key pharmaceuticals and vaccines, the United States can in fact be adequately prepared to deal with the specter of biological terrorism. It is my personal opinion that we are better prepared to deal with this problem now than any other nation on earth, but we can be much better prepared and I believe we will be in the very near future.